

Remarks

Reconsideration of the application is urged in view of the amendments above and comments which follow, the comments being directed to the various matters raised by the Examiner in the Office Action.

Specification

It is submitted that it will be readily apparent to a skilled reader that the disclosure referred to regarding a Linac source, when considered as a whole, relates to a Linac source which pulses to generate electrons, but only produces X-rays when the Linac is “triggered”. For example, it would be appreciated that a Linac of this type may include a series of RF cavities which generate electrons. These cavities are activated to generate electrons with each “Linac pulse”. Only when the Linac is triggered are the electrons caused to impinge on a target to generate X-rays.

Sampling the read-out system output between Linac pulses provides a measurement of any background signal, for example due to noise and crystal persistence (that is, the slow decay of light output from a stimulated crystal).

Measurement of a signal from the read-out system when the Linac is pulsed, but not triggered, provides an indication of any interference caused by the electron generation process.

The paragraph at the foot of page 8 referring to the Linac RF functioning in the untriggered condition throughout has been deleted.

Claim Objections

A number of objections were raised in the office action referring to “narrative language” in the claims. In several claims, applicants submit it is appropriate to retain the wording referred to, as

it serves to clarify the function of features to which it relates and/or their interactions. Otherwise, the wording objected to has been deleted.

The claims objected to which define intended uses of apparatus (claims 49 to 50, 55 to 56 etc.) have been deleted. Claim 44-46 have also been deleted entirely.

Claim Rejections – 35 U.S.C. §112

The claims have been amended as appropriate to address the points raised under this heading.

The clarity of the terms “pulse” and “triggered” in claim 98 is queried. However, it is applicants’ submission that they would be readily understood by a skilled reader, in the manner set out under the “Specification” heading above. Claim 99 has been deleted.

Claim Rejections – 35 U.S.C. §102

Claim 67

It is alleged by the Examiner that Neale et al (US5524133) disclosed all the features of this claim. However, claim 67 specifies that a thicker scintillation crystal is provided downstream of a thin crystal, with a low-Z converter in between. The Examiner refers to column 3 lines 53 to 58 of Neale which describes a series of high-Z converter sandwiched by a thin crystal, provided downstream of a first, relatively thin crystal. An embodiment is illustrated in Figure 15. There is no suggestion in this passage of column 3 that the downstream crystals could be thicker than the first, relatively thin crystal and indeed, in Figure 15, the downstream crystals are shown as thinner than the first crystal 172. Thus, there is no disclosure or suggestion in Neale of providing a thicker downstream crystal as defined in claim 67.

Claim 68

Neale et al is also cited against this claim, which can be distinguished therefrom in the same way as claim 67, in that it specifies a front thin crystal and a rear thick crystal, a configuration which is not disclosed or suggested by Neale. Furthermore, there is no indication in Neale that a thicker

rear crystal may be provided, with this single crystal being read-out at different depths in the beam direction, in the manner described in claim 86.

Claim 93

This claim is rejected as anticipated by Bjorkholm (US4511799). Claim 93 has been amended to emphasize that the front and rear scintillation crystals of the claimed detector are separate crystals, cut from the same ingot of material. In Bjorkholm however, two serially arranged detectors are provided by a single scintillating crystal. There is no disclosure or suggestion of a detector including two separate crystals which are cut from the same ingot in order to provide matched performance in two spaced apart crystals.

Claim 102

Claim 102 is rejected as anticipated by Neale. Use of a Linac as an X-ray source is disclosed for example at column 10 lines 55 to 56 as noted by the Examiner. However, contrary to the Examiner's assertions, there is no disclosure or suggestion of a Linac in which "the channels are normalised so as to overcome non-linear effects due to saturation", or calibration of a Linac "performed by increasing the X-ray beam flux by known increments".

In connection with the channel normalisation feature, the Examiner cites column 6 lines 48 to 52 of Neale. However, this concerns variations between one detector and another and variations in path length, rather than properties of the X-ray source. With regard to the calibration feature, column 11 lines 11 to 15 is cited. However, this paragraph refers to changing the X-ray energy when taking readings during an actual material discrimination process, rather than calibration performed prior to a measurement by increasing the X-ray beam flux by known increments.

Claim 111

It is submitted that the testing method defined in this claim is not disclosed or suggested by Neale, having regard to the passages cited by the Examiner. According to Neale, the mean number of X-rays transmitted through a region of a material when subjected to high energy X-rays, and then higher energy X-rays, is noted in turn and then the value of the ratio of these two mean numbers is calculated. An average atomic number is then determined from a look-up table which corresponds to the calculated ratio.

In contrast, according to claim 111, an object under test is inspected using high energy X-rays and low energy X-rays, rather than high energy and higher energy X-rays. Furthermore, an effective Z of constituents of the object is noted during each inspection, and it is these effective Z values which are compared and used to determine the identity of each constituent using a look-up table. Thus, the claimed method is clearly distinct from that presented in Neale.

Claim Rejections - 35 U.S.C. §103

Claim 83

Claim 83 is rejected as unpatentable in view of Neale, together with DiFilippo (US6078052).

Claim 83 specifies that “a thin front crystal is read out from each side ... and the output signals from the two opposite sides are added, so as to prevent any left/right asymmetry in an output signal”.

DiFilippo describes a scintillation detector including a scintillation crystal which has orthogonal sets of parallel optical fibers on opposite sides. Thus, when an orthogonal pair of fibers records photons at the same time, the source thereof is determined to be at the intersection of the two fibers. It will be appreciated that, for this to be achieved, output

signals from the two opposite sides of the crystal must not be added together, as this positional information would be lost. Indeed, there is no suggestion in DiFilippo of adding signals from two opposite sides of the crystal. Accordingly, DiFilippo cannot be said to render the content of claim 83 obvious, whether considered alone or in combination with Neale.

Claim 97

This claim is rejected as unpatentable in view of Grodzins (US6151381) together with Rivard (US2003/0204126).

As noted by the Examiner, Grodzins discloses an X-ray inspection system which may use a Linac as an X-ray source. Synchronization of detectors with the X-ray source is described with reference to Figure 4. However, contrary to the Examiner's assertion, there is no indication in Grodzins that X-ray detectors 26 and 28 comprise crystals.

The Examiner goes on to acknowledge that Grodzins does not disclose a material discrimination system in which the read-out system samples the output from crystals of the detector between each Linac pulse.

The Examiner asserts it would have been obvious for a skilled reader to turn to Rivard and thereby arrive at this feature. However, Rivard is not concerned with material discrimination using X-rays, but rather a quite different field, namely radiation therapy to treat diseases with ionizing radiation. Primarily, it is directed at novel methodologies for use in the field of radiation oncology (paragraph 0025).

In any event, the passage of Rivard (paragraph 0218) relied on by the Examiner concerns measurement of the dead time of a GM counter used in pulse mode. Thus, a period of time is being measured, rather than a background count rate as alleged by the Examiner.

For all the reasons given above, it is submitted it would not at all have been obvious for the skilled reader to arrive at the system claimed in claim 97.

Claim 109

This claim is rejected as unpatentable in view of Neale, in combination with Newman (US5420441).

With reference to Figure 1, it is asserted that Neale teaches a method of material discrimination using X-rays which is performed by generating calibration curves of material discrimination effect (MD) versus transmission (T), wherein the MD effect is derived from the lower and high energy signals. However, applicants cannot find justification for this.

Figure 1 merely shows the energy dependence of the transmission co-efficient for different materials, and accordingly shows a plot of this co-efficient against a range of energies. There is no reference to a method of calibration in relation to this figure, nor is there any reference to material discrimination effect, deriving the material discrimination effect from lower and high energy signals, or generation of calibration curves of material discrimination effect versus transmission. Thus, it is submitted that claim 109 is patentable over the paragraph outlined by the Examiner.

General Comments

The patentability of the independent claims is discussed above. It is submitted that the dependent claims are also allowable by virtue of their dependence on the independent claims.

For the avoidance of doubt, any subject matter no longer covered by the claims is not abandoned and may be the subject of further separate applications.

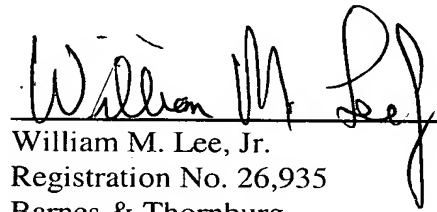
An appropriate petition for extension of time is also submitted herewith.

Finally, submitted herewith are Form PTO-1449, the \$180 fee, and the non-US references, all references having been cited in corresponding UK parent and divisional applications.

Further and favorable reconsideration is urged.

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Respectfully submitted,



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